WHAT IS CLAIMED IS:

1. A semiconductor device having a semiconductor layer comprising not smaller than two types of crystal grains different in average grain diameter in a semiconductor device circuit on a same substrate.

2. A semiconductor device comprising not smaller than two types of field effect transistors using a semiconductor layer directly or indirectly formed on the substrate as a channel region, wherein, a frequency distribution with respect to ratios of Na/L of the transistors falls within ±5%, where the L is a gate length of the transistor, and the Na is an average number of crystal grain boundaries across the direction of current flowing through the transistor.

3. The device according to claim 2, wherein the frequency distribution with respect to ratios of the Na/L of the transistors falls within ±2%.

4. The device according to claim 2, further comprising a circuit layer on the substrate for driving the transistor.

5. An annealing method comprising the steps of

setting target values with respect to intensity of laser light and distribution of the intensity in advance;

preparing a beam profile modulating section between a laser source and an irradiation region and preparing a substrate and a beam profile measuring

section so as to interchangeably load and unload into the irradiation region;

placing the beam profile measuring section in the irradiation region, emitting laser light from the light source, modulating the intensity of the laser light and distribution of the intensity by the beam profile modulating section, and measuring the intensity of the laser light and incident on the irradiation region and the distribution of the intensity by the beam profile measuring section;

adjusting parameters of the beam profile modulating section based on the measuring results such that the measuring results match with the target values;

placing the substrate in the irradiation region such that the incident surface of the substrate is positioned in the irradiation region, thereby aligning the substrate with the beam profile modulating section;

irradiating the substrate with the laser light modulated by the beam profile modulating section when the measurement results match with the targets; and

repeating the alignment step and the laser irradiation step to form a semiconductor substrate having not smaller than two types of crystal grains different in diameter therein.

6. An annealing apparatus, comprising

a laser source;

a beam profile modulating section arranged between the laser source and an irradiation region, for modulating intensity of laser light and distribution of the intensity;

a beam profile measuring section for measuring intensity of laser light of an incident surface of the irradiation region and the distribution of the intensity;

means for setting target values with respect to the intensity of laser light and distribution of the intensity in advance; and

a control section for controlling parameters of the beam profile modulating section such that the results measured by the beam profile measuring section match with the target values set above.

7. The apparatus according to claim 6, wherein the beam profile measuring section is arranged in the same plane as the substrate.

8. The apparatus according to claim 6, wherein the beam profile modulating section uses an image forming optical system having a phase shifter as a spatial intensity modulating optical element.

9. An annealing method comprising

setting and storing a target beam profile in a memory apparatus, recalling the target beam profile from the memory apparatus, setting an annealing beam profile with reference to the target beam profile thus

recalled, and irradiating a non single crystalline semiconductor layer with laser light.

10. The annealing method according to claim 9, wherein a beam profile of the most preferable laser light experimentally obtained is used as the target beam profile to be stored and read out from the memory apparatus.

11. The annealing method according to claim 9, wherein the target beam profile is a beam profile used in an annealing step and stored in the memory apparatus and recalled from the memory apparatus in the next annealing step.

12. The annealing method according to claim 9, wherein the target beam profile recalled from a memory apparatus and the beam profile of the laser beam during an annealing step are displayed on a display screen.

13. A method of annealing a non single crystalline semiconductor thin film comprising the steps of:

(a) inserting a spatial intensity modulating optical element between a laser source and a beam profile measuring section;

controlling gap d1 between an incident surface of the beam profile measuring section and the spatial intensity modulating optical element at 500 μm or less;

measuring intensity of laser light modulated by the spatial intensity modulating optical element and applied to the incident surface of the beam profile

measuring section, distribution of the intensity and the gap d, individually;

(b) inserting the spatial intensity modulating optical element between a substrate having the non single crystalline semiconductor thin film and the laser source, controlling gap d1 between an incident surface of the substrate and the spatial intensity modulating optical element to 500 μm or less, irradiating the incident surface of the substrate with the laser light modulated by the spatial intensity modulating optical element, and measuring the intensity of laser light, distribution of the intensity and the gap d1 when it is confirmed that lateral crystallization of the semiconductor thin film proceeds by irradiation of the modulated laser light;

(c) setting the measurement results in step (a) corresponding to those in step (b) as target values of the intensity of laser light, distribution of the intensity, and the gap d1;

(d) controlling intensity of laser light, distribution of the intensity and the gap d1 so as to match with the target values and irradiating the incident surface of the substrate with the laser light modulated by the spatial intensity modulating optical element under the control conditions; and

(e) forming a semiconductor layer having not smaller than two types of crystal grains different in

average diameter in the same substrate by repeating steps (b) to (d) mentioned above.

14. The method according to claim 13, wherein the target values of step (c) are stored and steps (d) to (e) are performed based on the target values by recalling the target values every time the substrate is irradiated with laser light.

15. The method according to claim 13, wherein the intensity of laser light, distribution of the intensity, and the gap d1 of step (b) are set such that the semiconductor thin film is crystallized, and laterally and stably grown without destroying the grown film.

16. The method according to claim 13, wherein, in step (b), temperature of the substrate is measured, the relationship between the substrate temperature, the intensity of the laser light, and the lateral growth is captured, and the substrate is heated in step (d) based on the relationship.

17. An apparatus for annealing a non single crystalline semiconductor layer by irradiating the single crystalline semiconductor layer with laser light, wherein annealing is performed by recalling a beam profile of the laser light from a memory apparatus and using the beam profile as a target beam profile for annealing.

18. The apparatus according to claim 17, wherein

the beam profile recalled from the memory apparatus is the most preferable laser light experimentally obtained.

19. The apparatus according to claim 17, wherein the beam profile recalled from the memory apparatus is a beam profile used in an annealing step, and stored in the memory apparatus, and used in the next annealing step by recalling it.

20. The apparatus according to claim 17, wherein the beam profile recalled from the memory apparatus is displayed on a display screen.

21. The method according to claim 13, wherein, in step (a), a fluorescent plate is provided on the incident surface of the beam profile measuring section and measurement is performed by placing the fluorescent plate at the same level as the incident surface of the substrate.

22. The method according to claim 13, wherein, in steps (a), (b) and (d), a phase shifter having a step portion for diffracting laser light is used as the spatial intensity modulating optical element and the phase shifter is designed such that a laser optical axis passes through the step portion.

23. An apparatus for appealing a non single crystalline semiconductor thin film, comprising:

a laser source,

a mounting table for mounting a substrate having

non single crystalline semiconductor thin film thereon;

a spatial intensity modulating optical element for modulating laser light from the laser source;

a beam profile measuring section having an incident surface, into which laser light from the laser source passes through the spatial intensity modulating optical element and enters, in the same manner as into the incident surface of the substrate, for measuring the intensity of laser light applied on the incident surface and distribution of the intensity;

alignment means for moving the substrate on the mounting table or the beam profile measuring section and the spatial intensity modulating optical element relatively to each other and adjusting gap d1 between the incident surface of the substrate or the incident surface of the beam profile measuring section and the spatial intensity modulating optical element at 500 μm or less; and

means for allowing the beam profile measuring section to measure the intensity of laser light and distribution of the intensity when it is confirmed that the non single crystalline semiconductor thin film is crystallized and laterally grown by irradiation of laser light modulated by the spatial intensity modulating optical element; measuring gap d1, setting the measuring results as the target values of the intensity of laser light, distribution of the

intensity, and gap d1, and controlling the operations of the beam profile measuring section and the alignment means such that the intensity and the distribution measured by the beam profile measuring section match with the target values.

24. The apparatus according to claim 23, wherein measurement is performed by arranging the beam profile measuring section such that the incident surface of the beam profile measuring section is arranged in substantially the same plane as the incident surface of the substrate.

25. The apparatus according to claim 23, wherein the beam profile measuring second has a fluorescent plate arranged in the same plane as the incident surface of the substrate for measuring the intensity of laser light and distribution of intensity.

26. The apparatus according to claim 23, wherein a phase shifter having a step portion provided for diffracting laser light as the spatial intensity modulating optical element, and the phase shifter is arranged such that the optical axis of the laser light passes through the step portion.

27. A thin film transistor for driving a pixel and a pixel drive circuit of a display apparatus, comprising:

(a) inserting a spatial intensity modulating optical element between a laser source and a beam

profile measuring section;

controlling gap d1 between an incident surface of the beam profile measuring section and the spatial intensity modulating optical element at 500 μm or less;

measuring intensity of laser light modulated by the spatial intensity modulating optical element and applied to the incident surface of the beam profile measuring section, distribution of the intensity and the gap d, individually;

(b) inserting the spatial intensity modulating optical element between a substrate having the non single crystalline semiconductor thin film and the laser source, controlling gap d1 between an incident surface of the substrate and the spatial intensity modulating optical element to 500 μm or less, irradiating the incident surface of the substrate with the laser light modulated by the spatial intensity modulating optical element, and measuring the intensity of laser light, distribution of the intensity and the gap d1 when it is confirmed that lateral crystallization of the semiconductor thin film proceeds by irradiation of the modulated laser light;

(c) setting the measurement results in step (a) corresponding to those in step (b) as target values of the intensity of laser light, distribution of the intensity, and the gap d1;

(d) controlling intensity of laser light,

distribution of the intensity and the gap d1 so as to match with the target values and irradiating the incident surface of the substrate with the laser light modulated by the spatial intensity modulating optical element under the control conditions; and

(e) forming a crystalline semiconductor layer having not smaller than two types of crystal grains different in average diameter in the same substrate by repeating steps (b) to (d) mentioned above.

28. A display apparatus comprising a pair of substrates joined with a predetermined gap between them and an electro-optical substance held in the gap, a counter electrode formed on one of the pair of substrates, a pixel having electrode formed on the other substrate; a crystalline semiconductor thin film electrically connected the pixel electrode, a pixel drive circuit for driving the pixel, and a crystalline semiconductor thin film formed on the pixel drive circuit,

each of said crystalline semiconductor thin film is formed by

(a) inserting a spatial intensity modulating optical element between a laser source and a beam profile measuring section;

controlling gap d1 between an incident surface of the beam profile measuring section and the spatial intensity modulating optical element at 500 μm or less;

measuring intensity of laser light modulated by the spatial intensity modulating optical element and applied to the incident surface of the beam profile measuring section, distribution of the intensity and the gap d, individually;

(b) inserting the spatial intensity modulating optical element between a substrate having a non single crystalline semiconductor thin film and the laser source, controlling gap d1 between an incident surface of the substrate and the spatial intensity modulating optical element to 500 μm or less, irradiating the incident surface of the substrate with the laser light modulated by the spatial intensity modulating optical element, and measuring the intensity of laser light, distribution of the intensity and the gap d1 when it is confirmed that lateral crystallization of the semiconductor thin film proceeds by irradiation of the modulated laser light;

(c) setting the measurement results in step (a) corresponding to those in step (b) as target values of the intensity of laser light, distribution of the intensity, and the gap d1;

(d) controlling intensity of laser light, distribution of the intensity and the gap d1 so as to match with the target values and irradiating the incident surface of the substrate with the laser light modulated by the spatial intensity modulating optical

element under the control conditions; and

(e) forming a crystalline semiconductor layer having not smaller than two types of crystal grains different in average diameter in the same substrate by repeating steps (b) to (d) mentioned above.